

Chapter 2.10

WATER MAIN DESIGN STANDARDS

The Department of Public Works and Utilities is assigned responsibility for administration of these design standards.

Section 1. GENERAL

The City of Lincoln Water System is regulated by the requirements of the Federal and State *Safe Drinking Water Acts*. Design and construction of facilities for the City's system shall generally follow the standards of the American Water Works Association (AWWA) and the *Recommended Standards for Water Works*, a Report of the Committee of the Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers (10-State Standards). Details of construction shall conform to the *City of Lincoln Standard Specifications for Municipal Construction* and the *Lincoln Standard Plans*. Fire flow requirements shall generally follow those in the *Fire Suppression Rating Schedule* published by the Insurance Services Office.

Section 2. WATER MAIN POLICIES

2.1 General

Lincoln Water System mains are designed to provide adequate flows for domestic and commercial uses and for fire protection, to protect the quality of the public water supply, and to maintain the integrity and reliability of the distribution system.

2.2 Pressure Systems

The City's water system is divided into five distinct pressure systems to serve differing elevations in the City. These systems are:

1. The Low Duty service area includes downtown, north and northeast Lincoln. System pressures range from 35 to 75 psi (241 to 517 kPa), hydraulic gradient - 1295 ft. (394 m) USGS.
2. The Belmont service area includes the Belmont, Highlands, and Air Park West areas. Pressures range from 35 to 105 psi (241 to 724 kPa), hydraulic gradient - 1380 ft. (421 m) USGS.
3. The High Duty service area serves the higher elevations in southwest to northeast Lincoln. System pressures range from 40 to 100 psi (276 to 690 kPa), hydraulic gradient - 1395 ft. (425 m) USGS.

4. The Southeast service area includes the area of Lincoln south and east of 56th and A streets. Pressures range from 40 to 100 psi (276 to 690 kPa), hydraulic gradient - 1480 ft. (451 m) USGS.
5. The Cheney Booster service area includes the area of Lincoln south and east of the Southeast service area. Pressures range from 40 to 100 psi (276 to 690 kPa), hydraulic gradient - 1580 ft. (482 m) USGS.
6. The Northwest Booster service area includes the area of Lincoln in the Fallbrook area and northwest portions at the Highlands. Pressures range from 40 psi to 100 psi, hydraulic gradient - 1460 ft USGS.

It is vital that these systems remain separate. New water mains must not create a connection between the pressure systems without provisions to maintain the separation of the systems. Consultation with the Public Works and Utilities Department and the Lincoln Water System will determine the boundaries of the systems. Facilities in areas where pressures are on the low end of these ranges may require that pressure boosting equipment be installed on the customers premises. Lincoln Water System's planning maps also show areas within the System Planning Limits where booster pressure systems must be constructed prior to development. These booster systems are contingent upon terrain elevations.

2.3 Provisions for Future Extension

In new developments, water mains shall be constructed in all public rights-of-way to the limits of the development to provide for future extension of the system. Temporary dead-end water mains should terminate with temporary hydrant assemblies.

2.4 Tapping Restrictions

Taps for customer service piping can be made to any water main up to and including 16 inches (400 mm) in diameter. All service taps shall be made by the Lincoln Water System. Detailed requirements for water main taps are contained in Title 17 of the Lincoln Municipal Code. Specific details may be determined by consulting with the Lincoln Water System. Service taps of $\frac{3}{4}$ - and 1-inch sizes are made using a corporation stop. All service taps larger than 1 inch are made using a tapping sleeve and valve. The minimum tap valve size shall be 4 inches. Services of 1 $\frac{1}{2}$, 2 and 3 inches are to be reduced from the 4-inch tap valve.

Each lot in a new subdivision must be provided an abutting water main. A residential lot at the end of a main should have a minimum of 20 ft. (6.1 m) of frontage on the main to be considered as having abutting frontage.

2.5 Systems Separate When Two Sources Supply Same Premises

On premises where water is supplied from two or more sources, a public water main being one of them, the systems shall be kept entirely separate to prevent any possibility of other supplies mixing with the public water supply.

2.6 Private Water Systems

Private water systems connected to public water mains shall be designed and installed under a Plumbing Permit in conformance with Title 24 of the Lincoln Municipal Code. All private mains, fire lines, building fire sprinkler connections and other connections to any public water main shall require permits and be approved by the Lincoln Water System. Meter and backflow prevention requirements are administered under Title 17 of the Lincoln Municipal Code. All fire hydrants located on private systems shall be identified by painting the hydrant as designated by the Lincoln Fire Department.

2.7 Easements

Permanent easements are required for all public water mains not located within the public street right-of-way. The normal easement width is 30 ft. (9.14 m). Easements wider than that may be required when conditions warrant. Where the water main is located near structures the easement must provide 15 ft. (4.57 m) lateral clearance between the main and the structures. If that clearance cannot be obtained, the water main must be installed in an approved encasement pipe.

An easement for a public main located along a private roadway should include the width of the roadway plus the area between the main and the roadway plus an additional 15 ft. (4.57 m) on the side of the main opposite the roadway.

Blanket easements are not acceptable. Easements granted for public mains should be specifically described with dimensions and angles sufficient to allow the easement to be accurately located. The dedication of any easement shall prohibit the location of permanent structures on, under or over the easement and shall allow the City access to the easement for construction, reconstruction, replacement, repair, operation, and maintenance purposes; and shall hold the City harmless for the cost of replacement or damage to any improvement or vegetation within the easement. Other appropriate or necessary requirements may also be included. A minimum of 5 ft. (1.52 m) of cover shall be maintained over the water main. Earth embankments, added subsequent to main construction, which increase that cover shall not be permitted without specific approval from the Lincoln Water System.

2.8 Feeder Main Extension Policy

The City has planned a network of larger feeder mains at approximately one half-mile intervals. The Developer shall consult with the Lincoln Water System to determine where such feeder mains are to be located and the size of main required.

2.9 Reviewing Agencies

All plans for construction of water system improvements shall be reviewed and approved by the Department of Public Works and Utilities, Lincoln Water System, Lincoln Fire Department, and if applicable the State of Nebraska Department of Health and Human Services, prior to construction.

Section 3. DETAILS OF DESIGN AND CONSTRUCTION

3.1 Main Size

The necessary size for water mains can be determined by consultation with the Department of Public Works and Utilities, Lincoln Water System and the Lincoln Fire Department. Considerations include:

1. The minimum main size is 6-inch (150 mm) diameter for residential areas, 8-inch (200 mm) diameter mains for commercial areas and 12-inch (300 mm) diameter for industrial areas shall be required unless it can be demonstrated that a smaller main will provide the proposed and future development with adequate pressure and fire-flow. Large industrial or commercial developments may require larger mains to assure adequate pressure and fire-flow. The City has established a feeder network of larger mains on approximately one-half mile intervals. A 12-inch (300 mm) diameter or larger main shall be required in these locations.
2. Residential areas require a minimum fire flow of 1500 gpm (94.6 lps) at 20 psi (138 kPa) residual pressure at any hydrant in the system. Fire flow requirements for other areas can be determined from requirements in *Fire Suppression Rating Schedule* published by the Insurance Services Office. The velocity in the main under non-fire flow conditions shall not exceed 5 ft. (1.5 m) per second.
3. If a network analysis is required for main sizing, it should be accomplished using the Hardy Cross method and the Hazen-Williams formula with a coefficient $C=120$. Equivalent network analysis methods may be used with the approval of the Public Works and Utilities Department.

3.2 Location

Water mains located in public or private residential streets should be placed outside of the roadway and 3.5 ft. (1.07 m) from the back of curb. They are generally to be located on the north or east side of the streets except in areas with curvilinear street alignments where this orientation may be varied to avoid conflicts between the sanitary sewers and water mains. The location of water mains in streets other than residential is subject to the approval of the Public Works and Utilities Department.

3.3 Horizontal Alignment

Water mains serving residential areas are to be constructed parallel to the centerline of the streets. On curvilinear alignments curves are to be accomplished by deflecting the pipe at its joints so long as the maximum permitted joint deflections are not exceeded. Minimum horizontal radii and the maximum allowable joint deflections are set forth in the *City of Lincoln Standard Specifications for Municipal Construction*. Where the curve radius requires pipe joint deflections greater than the amounts shown, bends must be used to negotiate the curved alignment. Bends should be chosen so that the main alignment is smooth and symmetrical.

3.4 Vertical Alignment

The normal depth of cover for water mains is 5 ft. (1.52 m) measured from the top of the curb, or finish grade, to the top of the pipe. The pipe should be designed and laid to line and grade and the grade should generally follow the finish grades of the street. The depth may be varied from 4.5 to 6.5 ft. (1.37 to 1.98 m) where necessary to follow the street grades. Vertical pipe joint deflections necessary to maintain the required cover shall be made at convenient locations and shall be limited to the permitted joint deflections set forth in the *City of Lincoln Standard Specifications for Municipal Construction*. Deflections greater than those permitted at pipe joints shall be accomplished using appropriate fittings.

3.5 Thrust Restraint

Thrust blocks shall be placed at all main terminations, bends, tees, plugs, and other fittings where reaction blocking is necessary to resist movement and joint separation. Thrust blocks shall conform to the details shown on the *Lincoln Standard Plans* and to the requirements of the *City of Lincoln Standard Specifications for Municipal Construction*.

Fire hydrants shall be installed with anchoring fittings and thrust blocks as shown on the *Lincoln Standard Plans*.

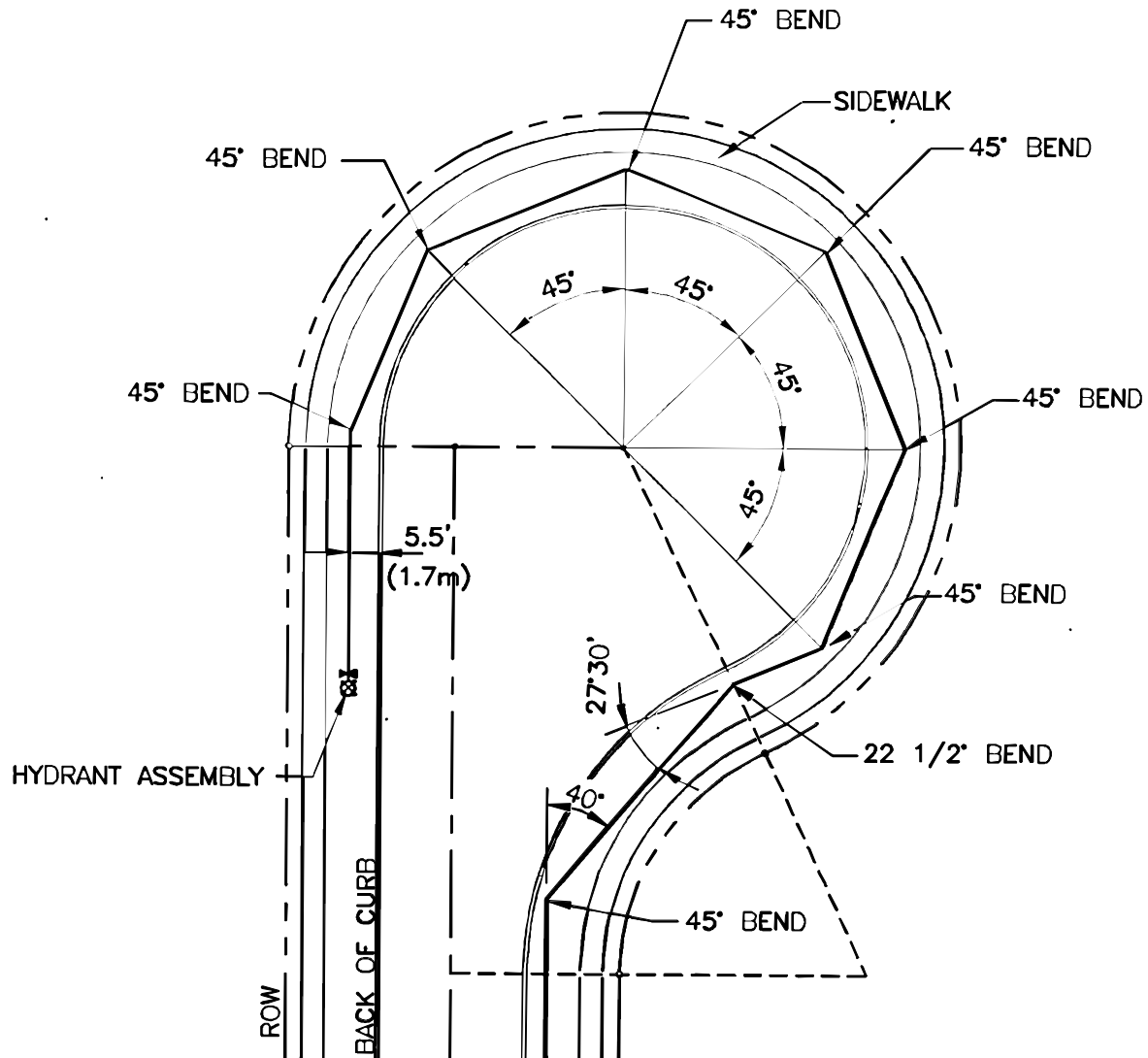
In situations where the water service can only be interrupted for limited periods, restrained joints shall be provided in addition to the thrust blocks to bear the loads until the concrete in the thrust blocks has gained sufficient strength to resist load application.

3.6 Dead-End Mains and Mains in Cul-De-Sacs

Whenever possible, all water main systems shall be designed to provide a complete system loop with all portions of the system having possible feed from at least two directions. This is generally not possible or required in cul-de-sacs.

Layouts generally showing how water mains should be placed in cul-de-sacs are shown in *Figures W1* and *W2*. The basic criteria being:

1. That all lots have access to the main at a point back of the curb.
2. That taps for all water services can be made on a portion of the main abutting the property to be served.
3. That a fire hydrant be installed at the end of the main, opposite a lot line between abutting lots.



NOTE:

1. Locate Hydrant opposite lot line extended to avoid driveway conflicts.
2. Provide thrust restraint at all bends and at hydrant assembly.

**WATER MAIN LOCATION IN
OFFSET CUL-DE-SAC**

FIGURE W-2

3.7 Backflow Prevention and Fire Flow Metering

Private systems containing fire hydrants shall have a double check valve assembly backflow preventer and a compound fire flow meter located between the private system and the public main. The backflow preventer and fire flow meter should be located on private property as close to the public main as possible. These devices shall be placed in a structure designed for protection from the elements, i.e., a meter pit or heated building. Details of a typical meter pit installation may be obtained from the Lincoln Water system.

Certain other water services as detailed in *Title 17 and Title 24 of the Lincoln Municipal Code* (such as swimming pools, chemical plants, sprinkler systems, etc.) are required to have backflow preventers between the public main and the private system to prevent contamination of the public water system. Specific requirements can be determined by consultation with the Lincoln Water System.

3.8 Fire Hydrants

The following considerations govern the placement of fire hydrants:

1. The entire area of the development must have adequate fire protection.
2. In residential areas, fire hydrants shall be placed at intervals of 420 ft. (128 m) measured along the centerline of the streets.
3. In commercial or industrial areas, along arterial streets or in other high-risk areas, the Fire Department may require additional hydrants be installed to provide adequate fire protection.
4. Cul-de-sacs longer than 150 ft. (45.7 m) but less than 400 ft. (122 m) from the curb line of the intersected street to the end of the right-of-way in the cul-de-sac shall have at least two fire hydrants, one at the intersecting street and one at the end of the water main in the cul-de-sac. A cul-de-sac less than 150 ft. (45.7 m) long needs only a fire hydrant at the end of the main. In no case shall the hydrant spacing, as measured along the street centerline, exceed 420 feet (128 m).
5. Fire hydrants are generally to be located about 5.5 ft. (1.68 m) behind the back of curb, opposite right-of-way corners or lot lines.
6. Where there is an option in location, the fire hydrant should be located where on-street parking is otherwise prohibited. For example, at a T-type intersection opposite either of the two right-of-way corners would be an appropriate location since parking within 30 ft. (9.14 m) of the intersection is prohibited.

7. Fire hydrants in private systems should only be used where there is no alternate location on a public main which would provide adequate protection.
8. Details of typical hydrant assemblies are shown on the *Lincoln Standard Plans*. Fire hydrants shall be installed in accordance with the *City Lincoln Standard Specifications for Municipal Construction*.

3.9 Valves

Valves should be spaced in feeder mains such that each feeder loop can be isolated. Distribution main valves should be spaced so that adequate shutdown capability is provided without placing large numbers of customers out of service. On 6-inch (150 mm) diameter mains, valves should generally be placed no more than 600 ft. (182.9 m) apart. Valve placement is subject to the approval of the Public Works and Utilities Department and the Lincoln Water System. Gate valves are used in mains smaller than 12-inch (300 mm) in diameter. Butterfly valves are used in 12-inch (300 mm) diameter and larger mains.

Valves should be located opposite street right-of-way lines or opposite abutting lot lines for ease in location.

In order to perform pressure testing and disinfection, new construction must be isolated from the existing system. Valves and/or temporary hydrants are used to provide such isolation. In some cases, existing valves may need to be replaced as a project cost. The Lincoln Water system will determine, based upon age, type, and repair history, which of the existing valves should be replaced.

3.10 Sewer Crossings and Parallel Sewers

3.10.1. Parallel Sewer and Water Mains

Water mains shall be separated by at least 10 ft. (3.48 m) horizontally from any existing or proposed parallel sanitary sewer. If, in the opinion of the Public Works and Utilities Department, extremely unusual conditions do not permit that horizontal separation, the water main may be laid closer to the sanitary sewer provided it is laid in a separate trench and the elevation of the bottom of the water main is at least 18 in. (457 mm) above the top of the sanitary sewer.

3.10.2. Sanitary Sewer Crossings

Water mains shall be laid at such an elevation that the bottom of the water main is at least 18 in. (457 mm) above the top of the sanitary sewer pipe. In those instances where the bottom of the water main is less than 18 in. (457 mm), above the top of the sanitary sewer or the sanitary sewer is located

above the water main, the sanitary sewer shall be constructed or reconstructed using a 20 ft. (6.10 m) length of PVC pressure pipe, meeting the requirements of AWWA C900 for DR18, Pressure rating 150 psi (1034 kPa), centered on the water main.

3.10.3. Clearance from Open Structures

All water mains should be laid with a minimum total clearance of 2 ft. (.61 m) from structures open to the weather, such as storm sewer inlets.

All sewer and water crossings must be approved by the State of Nebraska Department of Health and Human Services and the State of Nebraska Department of Environmental Quality.

3.11 Railroad and Highway Crossings

Plans and specifications for proposed installations on highway, county road or railroad rights-of-way shall be submitted to the appropriate railroad company, the Lancaster County Engineer or to the State of Nebraska Department of Roads for approval and the issuance of the required permit. The permit shall be obtained in the name of the City of Lincoln. All required permits shall be issued (or obtained) prior to final approval of plans. Water mains crossing railroad or highway rights-of-way, if required by the permit, shall be installed in an encasement pipe. Encasement pipes and appurtenances shall comply with the requirements of the permit and the *City of Lincoln Standard Specifications for Municipal Construction* and the *Lincoln Standard Plans*.